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ART. IX.—1. *Report of the Engineers on the Reconnoissance and Surveys made in reference to the Baltimore and Ohio Rail Road.* Baltimore, William Wooddy. pp. 189.

2. *Second Annual Report of the President and Directors, to the Stockholders of the Baltimore and Ohio Rail Road Company; and First Annual Report of the Board of Engineers to the Board of Directors of the Baltimore and Ohio Rail Road Company.* Baltimore. William Wooddy.

IN the fifty-sixth number of this journal, we took some notice of a project then recently set on foot, for constructing a Railway from the city of Baltimore to some point on the Ohio river. Besides the importance of such an enterprise to the Union at large, more especially to the flourishing states of the West, the bold design of constructing a rail road of such extent, and through a region apparently so difficult, at a time when the experiment of this mode of transportation had been made only for small distances, led us to expect with some interest, the farther proceedings of the projectors. Since the period of our first notice, the examinations of the country, originally commenced with a view to the construction of a canal between the same points, have been continued, and their results exhibited in the publications named at the head of this article; the last of which more particularly draws our attention, as it announces the actual commencement of the work, and holds out a flattering promise of its eventual completion. As various projects of the same or a like character are agitated in several parts of the Union, and especially in the commonwealth of Massachusetts, some farther particulars may be acceptable to our readers, relative to the enterprise in question; certainly one of the greatest ever projected in this,—we may add, in any country.

Indeed, the impulse lately given to schemes of this nature in the United States, and the rapid increase of the capital embarked in interior transportation, are among the most signal manifestations of the augmenting force and wealth of the nation. A glance at the map of the country discovers the greatest facilities for multiplying the channels of internal trade. Not only do our great rivers and lakes already afford to the vast surface which they drain, an extensive carriage of their products to some one market or other, but it is found that, by means of

the frequent connexion of their head streams, this advantage may be very greatly increased and diffused. As the Erie canal may be said to have turned the northern lakes into the Hudson and the bay of New York, rendering us thus far independent of the navigation of the St Lawrence, so the Ohio canals will open the same outlet to the interior of that state, and to the districts bordering on the Ohio river. Meanwhile, this magnificent tributary of the Mississippi, together with the Mississippi itself, wafts the products of their two wide and fertile basins to New Orleans, whence a great inner coastwise navigation may be continued, at a cost comparatively small, through the sounds, bays, and inlets of the coast of the Floridas, of Georgia, and the Carolinas, and through the Chesapeake and Delaware bays, and across Jersey, to New York. The lines thus described, encircle, with the exception of New England, the whole of the inhabited parts of the United States ; an immense extent of inland navigation, destined, together with the numerous works in progress or contemplated in various parts of the interior, to confer the greatest benefits on the most important branch of the commerce of all countries, the home trade. The route of the intended Baltimore and Ohio rail road is a line bisecting, from east to west, the area inclosed within the limits above described ; and, when completed, will possess the advantage of being the shortest line by which it can ever be bisected. The geographical circumstances which thus approximate Baltimore to the country watered by the Ohio, have been described by us, on a former occasion ; the advantages to be derived from this proximity are sufficiently obvious.

The statesman cannot be indifferent to these multiplying facilities of communication, which ensure the union of the members of the confederacy, by identifying their respective interests with each other. This, in free communities at least, is the true bond of empire ; and those who remember the irritations excited in the Western states on the subject of the navigation of the Mississippi, will be disposed to attach more weight to this opinion. Nor are these avenues of transportation less important in another aspect. A country so extensive as ours, so various in climate and soil, and so rapidly increasing its population, grows necessarily less dependent, every year, on foreign markets and manufactures, and must eventually be itself the great mart of its own products, and the great workshop of its own raw materials. But this result can in no way be so effect-

ually hastened, as by the improvement of roads and canals. The early civilization of most maritime countries shows, how necessary to commerce this facility of communication and transportation is ; nor is it to be doubted, that it is among the most efficient of the causes, which have given to the manufactures of Great Britain the market of the world. If many branches of manufacture, to which we seem otherwise entirely competent, have hitherto made small progress among us, it must be imputed in no small part to the want of quick and easy transportation, since the other elements of success are possessed by us in a preëminent degree ; abundant genius and activity in the people, a vast amount of water power, inexhaustible supplies of fuel, cheap and plentiful subsistence, and light taxes. Perhaps the roads and canals now in progress, will more efficiently foster our manufactures, than any bounties or protections ever could ; and thus the great question which divides the country, be settled by a policy equally acceptable to both parties.

If any one part of the Union can be said to be more interested in this policy than another, it is the Western states, both on account of their distance from a market, and of the vast amount of their disposable produce. From various causes, their exports, with equal facilities of carriage, would also more naturally seek an Atlantic port than that of New Orleans. The communication about to be opened to these states with New York, through the Ohio canal, lake Erie, and the Erie canal, and perhaps with Philadelphia, through the Pennsylvania canals, will doubtless be a most important acquisition to them, as an avenue both for their downward and their return trade. But during a considerable portion of the year, the rigor of the climate must close these canals, and that at a season, at which the farmer might prefer to take his produce to market. A transportation exempt from this obstruction, by a rail road, for example, on which neither drought nor frost can cause any delay, and conducting them, at the same time, to a port considerably nearer than either of the others, seems to promise such important advantages as to justify some labor and expense in procuring it, and has led the citizens of Maryland, of Baltimore principally, to the scheme of connecting their emporium with the West by a road of that sort. We could hardly give a stronger evidence of the progress of the nation, than by mentioning in connexion with such a scheme, that within the mem-

ory of many inhabitants of the West, all their salt, brandy, and many other articles, used to be brought across the mountains packed on horses.

The aspect of the country to be traversed by the railway, seems at first view little favorable to such an enterprise. The great range of the Allegany, rising to a height of twenty-five hundred and three thousand feet above tide, and the various subordinate ridges parallel to it, all lying in a transverse direction to the general course of the road, are so many barriers to be surmounted by it in its progress westward. The control, so to speak, of this principal range over the subordinate ridges, appears not only in the more important of them, as the Catoc-tin, the South Mountain, and the Blue Ridge on the east of it, and the Laurel Hills and others on the west, but in the lesser hills and collections of rocks occurring in the same region. The ridges interposed between Baltimore and the Potomac, which are found to be much higher than was commonly supposed (having an elevation of eight or nine hundred feet), preserve, with the same obstinacy, this direction transverse to the intended route. Even where these mountain barriers have been worn away, or broken through by the large rivers, the Potomac on this side of the mountains, the Cheat river, the Youghagany, and Casselman's river on the other, the change has been wrought with such violence, as to leave the surface extremely rough and broken and to render much labor necessary, to accommodate it to the road. It may be remarked, however, that in the event of completing the railway across these ridges, the intermediate valleys will offer great facilities for the construction of lateral roads, leading into the main trunk, and swelling its trade, by the products of a proportional extent of country.

But, though such is the general character of this region, a more particular examination demonstrates it to be penetrable to a railway, through its whole extent. Indeed, as far as Cumberland, a town on the Potomac, near the foot of the Allegany, (a point of great importance from the exhaustless quantities of the best coal which are found in its vicinity) there may even be selected a route of extraordinary facility. An avenue being thus found to the base of the great ridge, dividing the eastern and western waters; and the country westward of that ridge towards the Ohio, either presenting a surface of gentle undulations, or having its rocky ridges penetrated by the action of

the rivers ; it is on the Allegany alone that serious difficulties may be expected to occur. But, as this region, after a minute survey by the United States' Board of Internal Improvements, has been pronounced by them to be practicable for a canal, 'we may,' say the Engineers, in their Report, 'conclude *a fortiori* that a rail road may be made over the same ground.' But that our readers may estimate for themselves the probability of this bold enterprise being brought to a successful issue, we shall, from the materials furnished in the Reports named at the head of this article, give a description somewhat more particular of the proposed route of the road, and of the country which it traverses, beginning at Baltimore.

The construction of the road was commenced, at the western limit of that city, on the fourth of July last, with a pomp indicative of the general confidence of that community in the practicableness of a scheme, in which its prosperity is very deeply concerned. The venerable Mr Carroll, the only signer of the Declaration of Independence now alive, laid the first stone. Its whole route may be considered in three divisions, including the country between Baltimore and the base of the Allegany, that comprehended in the Allegany and the two great ridges parallel to it on the west, and that lying beyond the foot of the latter to the Ohio, respectively.

The distance between Baltimore and Cumberland, the extreme points of the first of these divisions, is, by the present turnpike road, one hundred and thirty-seven miles. The character of this extensive district is broken, hilly, and sometimes mountainous, being crossed by a number of those elevated ridges, which we have described as subordinate and parallel to the Allegany. But it has been ascertained that, by following the direction of the tributaries of the Patapsco and of the Potomac, and then the Potomac itself, these may either be entirely avoided, or, at least, gradually surmounted, without any great deflection from a straight line. The only one which must unavoidably be crossed, is the 'Parr's Spring Ridge,' dividing the waters of the Patapsco and the Monocacy, the former of which streams empties, as is well known, into the harbor of Baltimore ; the latter is a tributary of the Potomac. The eastern foot of this ridge may be approached along the western branches of the Patapsco, and from its western base run the tributaries of the Monocacy, by means of which the Potomac may be reached at the 'Point of Rocks,' a promontory, which ter-

minates the Catoclin mountain on that river. By passing round this promontory by the margin of the stream, the Catoclin ridge is avoided, and the road enters the valley of the Potomac, at a point, distant from Baltimore, by the ordinary route, fifty-five miles. Hence to Harper's Ferry, is found either a *flat* sufficiently wide for a road, or a moderate slope to the river; and like facilities occur from Harper's Ferry to Antietam, a distance of eight miles, there being everywhere sufficient space between the hills and the river except in one or two places, where cliffs of limestone, nearly perpendicular, rise fifty and seventy feet from the water. Within four or five miles of Antietam, wide and beautiful bottoms offer every facility for the cheap and easy construction of the road. Beyond that point, the sinuosities of the Potomac become so numerous, that a departure from its course is necessary in order to diminish the distance; but fortunately the face of the country allows this abandonment of the stream, and the road may be carried with no difficulty to the Conococheague at Williamsport, in a line nearly direct, and not exceeding sixteen miles, little more than half the distance by the river. To attain, however, the general level of the country beyond the Antietam, where the road thus diverges from the Potomac, an elevation of one hundred and fifty feet must be overcome, though this may be effected pretty gradually through some one of the numerous ravines which occur at that point. The elevation thus reached may be sustained by moderate cuts and embankments till the road descends again to the valley of the Conococheague, at Williamsport. This point is about seventy miles from Baltimore, by the ordinary road.

Proceeding beyond Williamsport, we begin to encounter the more considerable of the subordinate ridges parallel to the Allegany, and consequently to find the surface more rough and broken. The road, therefore, will conform pretty generally to the immediate bank of the Potomac, the great objection to which is the sinuosity of the stream, while the ground intervening between the bends is generally too high to be crossed. For several miles, however, before approaching Hancock, twenty-four miles beyond Williamsport, the river pursues a very straight course, presenting banks, at the same time, remarkably favorable for the work. West of Hancock, the valley of the river must of necessity be pursued, as the numerous mountain ridges crossing the route, of which Sideling Hill is the princi-

pal, are unbroken by any gaps, or even depressions, but such as have been made by the Potomac. Supposing this plan to be pursued, the distance from Williamsport to Cumberland, may be estimated at eighty-four miles, with an ascent of two hundred and seventeen feet.

Cumberland, we have said, is one hundred and thirty-seven miles from Baltimore. In the whole of this distance, which conducts us to the base of the Allegany, over a country so unpropitious at first view, there occurs no obstacle of serious magnitude, to the construction of the contemplated road, on principles too, the most convenient to the passage of the downward and upward trade respectively. At one place only, we believe, will it be necessary to employ stationary power ; at the point where the road will cross the Parr's Spring Ridge.

We have now to consider the second division of the route, namely, the region of the Allegany, and its parallel ridges, as the Briery and Laurel Hills, westward of which last, as we have already mentioned, the country presents a much more practicable aspect, indeed a character altogether opposite. Commencing then, at Cumberland, two routes present themselves by which to traverse the Allegany region, and reach the western waters. The first, which was examined before the rail road company had obtained permission of Pennsylvania to enter her territory, continues up the valley of the Potomac as far as the mouth of Savage river, a tributary of that stream, and thence, by means of the ravines of the Savage, and of one of its tributaries, Crabtree creek, ascends the Allegany mountain, and so passes over to the tributaries of Cheat river. The stream last named is a principal branch of the Monongahela, which, as the reader knows, enters the Ohio at Pittsburg. From the Cheat and the Monongahela, this route would have passed to the Ohio by means of the valley of some one of the several tributaries of that river, which it would have struck at some point, between the little Kenahwa and the southern boundary line of Pennsylvania. The second route from Cumberland, which would immediately enter that state, proceeds up the valley of Will's creek (also a tributary of the Potomac), to some point where the ascent of the Allegany may be made to advantage, and then strikes over to the valley of Casselman's river, a stream flowing into the Youghagany, which itself runs into the Monongahela, a few miles above Pittsburg. The valleys of Casselman's river and the Youghagany open a passage

through the Briery Hill and the Laurel Ridge ; and it is believed, that the superior facilities of this route to the Ohio will cause it (now that the company may enter Pennsylvania) to be selected for the extension of their road. We return, however, to the description of the first route we have mentioned across the Allegany region, that our readers may perceive what difficulties it was designed and deemed practicable to surmount.

From Cumberland to the mouth of the Savage, the rapidity of the Potomac is very considerably increased, there being a fall of not less than three hundred feet in twenty-nine miles. The valleys of the Savage and of Crabtree creek are extremely rough and wild, and the ascent very great, exceeding sixteen hundred and eighty feet in sixteen and a half miles. This ascent overcome, and the summit of the Allegany and the Glades attained, the next difficulty is to descend into the valley of Cheat river, a stream buried in high mountains, throwing their steep slopes close to the water's edge, and hardly accessible to human foot. These precipices rise from the brink of the stream at an angle of forty or fifty degrees, to the height of seven or eight hundred feet. Such is the wildness of this tract, that the Engineers were three days industriously employed, in making a distance of sixteen miles. Our limits will not allow us to describe the various routes by which the descent to the valley of the Cheat, down these rugged precipices, was proposed to be accomplished. The most precipitous of them, which was in other respects, however, the most favorable, would have presented a declivity of one thousand one hundred and ninety-six feet in four miles and a half. The Cheat, as we have said, is a tributary of the Monongahela. In order to reach the latter, the alternative was presented of either crossing the peninsula which divides them, or of pursuing the Cheat to its confluence with the principal stream. The most favorable route across the peninsula presented an aggregate ascent of one thousand one hundred and thirty feet, and a descent of one thousand two hundred and sixty, in a distance of thirty-three miles and a quarter. These obstacles surmounted (which, though by no means invincible, appear, it must be confessed, sufficiently formidable), we have traversed the Allegany, with its parallel ridges, the Briery and Laurel Hills, the second of the divisions under which we purposed to consider the route of the railway. Fortunately, the direction of Will's creek, Casselman's

river, and the Youghagany, presents the means of doing this with much less labor and expense. The distance from Cumberland to the junction of the Cheat with the Monongahela, just beyond the western foot of the Laurel Hill, may be estimated at ninety-eight miles.

Having cleared the defiles of the great Back-bone of the United States, the passage of the road to the Ohio, along the valleys of its tributary waters, is easy enough. Of the route through Pennsylvania, by the Youghagany, the Engineers speak thus. 'After passing the Laurel Ridge by the valley of the Youghagany, we may,' say they, 'from the favorable direction of the different tributaries of the Monongahela and the Ohio, prolong the rail road to a point on the latter as far south as the Pennsylvania line, or even to the mouth of the Little Kenhawa; or we may continue down the valleys of the Youghagany and Monongahela, to the city of Pittsburg.' This route has been shown, on surveys made by them on a former occasion, to be practicable for a canal. We need not enter into a particular description of it, as a more minute survey will be made hereafter. So, too, the prolongation of the road from the Monongahela to the Ohio, by the more southern route of the valleys of Buffalo and Fishing creeks, forms a strong contrast with its passage across the summit level, by the Savage, the Crabtree and the Cheat, to the Monongahela. Buffalo and Fishing creeks, the former of which runs into the Monongahela, and the latter into the Ohio, are divided from each other by a narrow ridge only a quarter of a mile wide at its base, and only eighty or ninety feet high; an elevation so moderate that it is a little singular that the Monongahela did not break through it to join the Ohio, instead of being thrown so far north, through much greater obstacles, to meet that river at Pittsburg. The probability of the road's entering Pennsylvania, renders it unnecessary to describe minutely the route by Buffalo and Fishing creeks, or another by the valley of the Cheat and the Monongahela, to the Ohio. Nor shall we notice the examinations detailed in the Engineers' Report, of the country in the direction of the Great Kenhawa, by the way of the Shenandoah, and the South Branch of the Potomac, to the Greenbrier, farther than to mention the practicability of rail roads through these extensive districts, rich in agricultural and mineral products, that naturally tend towards the valley of the Potomac in search of a market.

The general direction of the route of the railway, as thus described, is, from Baltimore to the 'Point of Rocks,' a little south of west; thence to Hancock, approaching north-west. From Hancock to Cumberland, the general direction is very little south of west, though there is a great circuit in consequence of the direction of the river. Beyond Cumberland, by way of the Cheat, to the western base of the Laurel Ridge, the course, though winding, is included between south-west and west. Thence to the Ohio, the direction is nearly west. Should the route by Casselman's river and the Youghagany be adopted, the general direction from Cumberland to the mouth of Casselman's river, and thence by the Youghagany to Pittsburgh, would be north-west.

From this necessarily brief description of the three regions through which the rail road is to pass, our readers will have perceived, however, that in its whole extent, its practicableness is beyond doubt. In the western division, extending from the base of the Laurel Hill to the Ohio, there is, on any of the routes, so little serious difficulty to be apprehended, that the ground, on the contrary, is in a high degree favorable. The character of the Allegany, and the other ridges forming with it the height of land between the eastern and western waters, is certainly very different. But of the two principal routes across it, one is by no means impracticable; the other is expected to afford much greater advantages. Of the eastern division, the examinations are already so accurate as to evince the perfect facility of its construction. We shall here add some particulars of this last section of the route, embraced between Cumberland and Baltimore, as it has received a more minute examination than the others, and as an actual commencement has been made on a part of it, the twenty-four miles between Baltimore and the fork of the Patapsco above Ellicotts' Mills.

The definitive *location* of these twenty-four miles was begun on the south-west boundary of the city, on the seventh of July last. At the very edge of the town runs a primitive ridge, which though narrow, extends through several of the middle states, in a direction from south-west to north-east, upholding, as it were, the country beyond it, and giving to the streams which cross it that very rapid fall, which forms a great part of the water-power in the neighborhood of Baltimore. This topographical circumstance, besides the consideration of introducing the road into that part of the town already built on (em-

bracing some considerable eminences), rendered expedient the adoption of a great elevation through the first twelve miles, no less than sixty-six feet above tide. This elevation, though it is so much gained, in reference to the subsequent part of the route, involved an extraordinary expenditure in the outset of the work, two sections alone, not exceeding one thousand three hundred yards in length, and including the 'deep cut' of seventy-eight feet depth, costing one-third of the total expense of the first twelve miles, which however, notwithstanding this accumulation of expense on a particular point, will not average for graduation and bridging, more than seventeen thousand dollars a mile, though they include a viaduct of two hundred feet across the Patapsco. It was never anticipated by the Engineers that the graduation and bridging of this portion of the route could be executed for less than double the cost of any other equal distance of the whole route, so far as it has been examined, or indeed, as they confidently assert, throughout the whole extent between Baltimore and the Ohio. On the twelve miles next above Ellicotts' Mills, the graduating and bridging may be effected for one-fifth of the average cost per mile of the portion between these mills and Baltimore; and it is added that the entire cost of the twenty miles along the Patapsco above the mills, will not exceed that of half a mile at the deep cut already mentioned. The Engineers allege that the extraordinary cost of the few sections nearest to Baltimore, has arisen from circumstances wholly unlikely to recur on any future parts of the route.

Besides the great elevation adopted, it was determined, in order to avoid any inclined plane on this part of the route, to maintain a *level* from the city to the valley of the Patapsco; to which must be added the distance of the materials from some part of this section of the road (stone not being at hand, and timber procurable only through importation by water); and also the inexperience of the workmen, and the general want, and even ignorance, of the machinery and tools best adapted to road-making. In fine, however, the average cost of preparing the first forty miles for the reception of the rails, will not exceed eight thousand dollars a mile; and with the most liberal allowance for laying the road with double tracks, and completely fitting the rails for the reception of carriages, and the application of the moving power, the total cost per mile throughout that distance, is not expected to exceed seventeen thou-

sand dollars. The computed cost, we believe, at the inception of the enterprise, was twenty thousand dollars.

The contractors have commenced work on the section between Baltimore and Ellicotts' Mills, and are rapidly advancing. A part is already finished for the reception of the rails, and there is every reason to expect that the graduation and masonry of the whole of it, together with some farther portions, will be completed by the first of June next. The contracts, notwithstanding the shortness of the notice, were readily taken, at fair prices; and the improvements already introduced in the performance of the work, such as temporary railways for the removal of the earth, with others, will not only reduce the cost to the contractors, but will be beneficially felt in future contracts. Meanwhile, surveys are in progress, in order to a final location of the road. These have already been made on the principal points, as far up the valley of the Potomac as Cumberland.

The localities, through which the above surveys have been conducted, are found, so far as the surveys are complete, highly favorable to the structure of the road. The natural surface in the immediate vicinity of the route, is generally firm, and well adapted to its support. Quicksands never occur; the hills are never so abrupt as to require tunneling; and though the course of the road, in order to preserve a level, is necessarily serpentine, the distance on the most favorable routes is far less augmented than might be supposed. Cliffs and precipices sometimes present themselves; but none of such extent or difficulty as not to be overcome at an expense comparatively moderate. The necessary timber is found in most parts beyond the immediate vicinity of Baltimore; but locust, though it abounds in some places, is not generally near at hand. The valley of the Potomac, frequently bounded indeed by rugged precipices, passable only by means of artificial road-ways, cut into the cliffs, or supported by walls reared from the bed of the river, is for the most part, nevertheless, easy of passage. The rocky *débris* at the base of the river hills not only afford a foundation, but supply the materials for constructing the bed of the road at a cheap rate, as also for the numerous small bridges and culverts that will be required. Good building stone is found almost universally. Stone rails can be delivered on the route at the moderate price of eight cents the running foot; locust sleepers for the same purpose, at twenty-five cents each;

white or rock oak for much less; and yellow pine for three cents the running foot. The timber for the wooden bridges, necessary in a few places, may be procured for eight dollars the thousand feet. Brick clay of uncommon excellence is obtainable in every part of the country. It deserves a particular mention, that between Baltimore and Cumberland, a distance by the rail road of one hundred and eighty miles, there occurs but one point, namely, Parr's Spring Ridge, where resort to an inclined plane, with stationary power, is absolutely necessary; for though it may be found convenient to employ a small stationary power on entering the valley of the Potomac, and near Williamsport, it is by no means inevitable. A like instance is wholly unparalleled in the history of works of this nature. The elevation to be thus overcome at Parr's Spring Ridge, is about five hundred and fifty feet. We may add another circumstance of no small moment; that, as the downward trade between Baltimore and Cumberland is so vastly more bulky than the upward, the acclivity towards the west is not an obstacle, but so much actual power gained. It is, indeed, not only an advantage fully countervailing the partial use of stationary power, but is more propitious to the exchange of commodities between these two points, than a perfect level through the whole distance.

A very important point of construction, is the proper graduation of the road. If the trade on it travelled all one way, this would be simple enough. But as this is not the case, and as the bulk and weight of the commodities are very different in the downward and in the return trade, it is necessary, in order to the just employment of the moving power, to adapt the graduation, as nearly as may be, to the relative amount of transportation from Baltimore westward, and from the Ohio to Baltimore, respectively. The route which connects them may, as regards this view of the subject, be divided into two sections, of which the point of division is the extensive coal region near Cumberland, whence a great amount of that article may be expected to travel eastward, and very little westward. At the same time, large quantities of iron and marble will probably be carried westward, thus counterbalancing in a great degree the heavy produce conveyed eastward, and contributing to render the reciprocal traffic more equal on the western than the eastern section, on which last the principal articles carried upward, will be groceries, dry goods, and other commodities,

light in proportion to their value. To adjust the relative weight of the commodities thus exchanged, involves, it is manifest, some nice calculation. The Engineers have assumed, however, that every ton conveyed from Baltimore to Cumberland, will be equal in value to five tons in the opposite direction; and every ton from Cumberland to the Ohio, worth two tons the other way. Hence, were it possible, such a uniform inclination should be given to the road that a given power should be sufficient to propel on the eastern section, in addition to the carriage, an amount of tonnage in the direction of the heaviest trade, five times as great as in that of the lightest; and on the western section, double the amount. This indeed, from the varieties of surface, is impossible; and a more complicated system of graduation, having reference to the different localities, must be resorted to, on the basis, however, of the principle just described. There are three elements that enter into a calculation of this sort; the proportion spoken of between the outward and return transportation; the proportion of the weight of the carriage to that of its full load, which is estimated as one to three, that is, that a carriage weighing one ton may be made strong enough to convey three tons; and the ratio of the load to the propelling power, assumed to be one hundred and fifty to one, that is, that a traction of one pound will draw on a level rail road one hundred and fifty pounds. The result deduced from these *data* is, that the inclination of the road, ascending from Baltimore towards Cumberland, should be at the rate of 15·086 feet per mile; and of 8·12 feet per mile, ascending from Cumberland towards the Ohio. Tables accompany the Report, exhibiting the graduations conformable to these principles, and to the various localities occurring.

The road will be constructed in the following manner. The usual width of rail-tracks in England is about five feet *from out to out* of the rails, or four feet six inches between the rails, with the addition of one inch for play between the flanges of the wheels and the rails. The width of the Quincy railway is about five feet between the rails; that of the Mauch Chunk three feet and seven inches. On the present road, four feet six inches and a half are suggested for the width between the rails, half an inch of which is allowed for play between the rails and flanges. The width of each rail is proposed to be two inches and a quarter, making the aggregate width of the rail-track four feet and eleven inches. A double railway, of

course, requires double the width just mentioned, together with a space of at least two feet between the inner rails of the two tracks; making the width of the double railway twelve feet. The road-way, besides, should be formed outward from the tracks about three feet on each side, in order to give a firm support to the road. Thus, the entire width of the road will be eighteen feet, which will admit loads occupying a width of seven feet, to pass each other on the rail-tracks; and there must be added six feet and a half for every additional track, turn-out, or *viaduct*; which may be made at intervals not exceeding a mile. Two modes of construction are proposed; one applicable to situations affording a solid foundation; the other, where, embankments being necessary to form the bed of the road, much time will be required for its settling and consolidating.

The former consists in forming the bed on the natural surface, or excavating so as not to disturb its solidity; or by constructing the bed of stone, so as to make at once a stable foundation. The bed being prepared, trenches eighteen inches or two feet wide are to be formed for the reception of stone rails, resting on broken stone. The rubble stone is to be laid in the trenches to the depth of six or eight inches, and stone rails, three, six, or eight feet long, and twelve, fifteen, or eighteen inches broad, with a thickness of six or eight inches, (undressed except at the ends, which must be made to form a square juncture, at least at their upper edges,) are then to be laid edgewise in the trenches, and so adjusted as to bear fully and equably on the rubble stone. Paving stone, of the size proper for a *Macadamized* road, is then to be thrown into the trenches on both sides of the rails, and on the road-bed, to the entire width mentioned above, raising it nearly to the level of the upper edge of the rails. This pavement, by ramming and rolling, is then not only to be made solid, but impervious to water, which last is to be effected by the detrition of stone to fill the interstices; and the stone rails are then to be dressed on their upper surface, to the width of about two inches and a half, in exact conformity to the plane of the road. To these are to be applied plate rails of wrought iron, from eight to twelve feet long, two inches and a quarter wide, and half an inch thick, confined by iron rivets. To obviate the effects of the expansion and contraction of the metal, the rivet holes are to have an elliptical form. Scuppers for draining the water will

be formed at intervals of three or four hundred yards, and bridged by iron plates. In situations where a temporary structure is advisable, wooden sleepers will be substituted for the trenches. These will be laid transversely to the road, at distances corresponding to the length of the rails, and furnished with notches for wooden rails of oak, hard pine or chestnut, faced with iron plates as before, and connected by ties extending across the road. The spaces between the sleepers are to be filled with rubble stone or gravel, so as to form a road-bed. When the embankments settle, and the wood shall have decayed, stone rails will be substituted, after the mode first described.

Some particulars taken from the Engineers' Report, will show the various impediments occurring in the construction of a rail road, and in what manner it is designed to overcome them. The first are the undulations of the surface. It is a principle, that horizontal flexures are admissible, but that vertical ones are to be avoided ; that is, that a serpentine road is better than one of alternate ascents and descents. But to preserve the same plane, the inequalities of surface must be avoided either by making a circuit round them, or by deep cuts, embankments, or bridges leading across them. Several obvious considerations render the first of these preferable at this time, and it is accordingly recommended by the Engineers, more especially on account of the facility which railways afford of making improvements in both their location and construction at any subsequent period. The subject of curvatures in these roads seems seldom, say the Engineers, to have attracted the notice of writers upon them. Any curvature whatever must necessarily be a defect, because, in addition to the increase of distance, there arises, from the difference of the length of curve in the interior and exterior rails, a sort of longitudinal sliding, or friction equal to that of dragging half the load without wheels through a distance equal to the difference spoken of. It is believed, however, that this difficulty may be almost entirely obviated by a different construction of carriages from that now in use. In Great Britain curvatures are frequently met with, of a radius not exceeding three hundred, or even two hundred and fifty feet. The former is the least radius of curvature at Quincy ; the least at Mauch Chunk is four hundred and thirty-seven feet. The surveys of the experimental lines on the present road have been conducted on the assumption that no curvature with a radius of less than four hundred feet is

admissible. Another impediment in construction is the passage of ravines and water-courses, which must be effected either by culverts or bridges. Here the culverts are to be of stone, with a span not exceeding ten feet; those of six feet and upwards, to be formed of abutments and arches constructed in the usual manner; and those of less span, like the Gothic culverts on the national road west of Wheeling. The bridges will be built of yellow pine, resting on stone abutments; the mode of construction that of Burr. Wooden bridges are preferred, their first cost being so much less than that of stone bridges, that the interest on the additional capital required for the latter is sufficient to keep those of wood in complete repair. Stone bridges are more liable to injury from frost, the dilapidating effects of which are unavoidable in the climate of the country to be traversed by the railway. Derangements in the line of the road, occasioned by the settling of the abutments and piers, can be more easily rectified when the bridges are of wood; and the necessary repairs more readily made, and with less obstruction to the transportation.

That the Allegany ridge can be crossed by any road of this nature without serious impediments from the abrupt slopes and precipices of that region, is of course not to be expected. The most formidable of these are the steep and rocky river-banks, which often present perpendicular fronts of great height, while their bases are washed by copious streams, occasionally swelling into torrents. To the difficulty of forming the road-bed in such situations, must be added that of securing it from avalanches of earth and stones, which can be effected by hardly any other means than by increasing its width. Side walls, of greater or less height, must be erected for the support of the road, and a broad drain formed between it and the hill-side, for the reception of the earth and stones that may be detached from the latter. A yet greater difficulty is to raise the road above the reach of freshets, and secure it from violent currents of water. Over low grounds, often inundated, it must be conducted at a considerable elevation; and along precipitous slopes, against which the currents, in high water, impinge with violence, strong walls of heavy stones must be built on the bed of the stream, and raised beyond the utmost height of freshets ranging often from ten to forty feet.

But the greatest impediments of all are such hills and mountains as are of too great extent and elevation either to be trav-

ersed by a deep cut, or perforated by a tunnel. In ascents where part of the gravity of the load must be overcome in addition to the friction, the power required for locomotion must be increased in proportion to the angle of ascent ; in descents, again, where there is an excess of gravitation beyond the friction, the too rapid descent of the load must be prevented by suitable *brakes* or *convoys*. In respect, also, to the former, the advantage of a railway over an ordinary turnpike road decreases with the increase of the angle of ascent ; and when the descent exceeds an angle of three degrees, brakes attached to the carriage will not adequately retard the descent, and stationary brakes and convoys must be resorted to. The expense of overcoming ascents will of course vary with their height, except where adequate water-power is attainable ; that of descending involves only the cost of suitable convoys, and of conveying down the motive power. That cost would be considerable if horses were employed ; but could be avoided by stationary machines, whether moved by water, steam, or horses.

In regard to the latter power, the Engineers' Report contains the following estimates. The force or traction of a horse, moving at the rate of two miles an hour during ten hours of the day, is commonly computed to be equal to one hundred and twelve pounds. When the daily duration of his labor is less than ten hours, the degree of traction will be proportionably greater, till it amounts to about two hundred pounds ; and so, when his movements are accelerated beyond two miles an hour, it will be proportionably diminished. A horse therefore, moving two miles an hour, will communicate a force twice as great as when he moves four miles ; or the number of horses requisite to propel a given load, must be doubled when the speed is doubled. This rule, however, is applicable only to velocities beyond that at which a horse can exercise his full strength to the greatest advantage, namely, two miles an hour. A somewhat analogous reasoning, it is added, is applicable to ascents where a portion of the horse's gravity forms a part of his load ; and when the angle of ascent equals eight degrees, his power, over and above what is necessary to his own progress, vanishes altogether. However seemingly discordant these conclusions with common experience, they must, says the Report, be taken into account in every question as to the application of animal power. Again, if steam power be employed, its effect on the load will be in direct proportion to the velocity, and, in contrast with

animal labor, affords the following results. A steam power equivalent to that of one horse *actually hitched*, or a traction of one hundred and twelve pounds, and moving at the rate of four miles an hour, will be equal to that of two horses moving at the same rate; and the same steam power, with a velocity of eight miles an hour, will be equivalent to that of four horses laboring in a manner to produce the greatest useful effect.

It appears, when steam is employed, that the quantity of coal requisite for surmounting heights, is at the rate of one pound per ton for every 35·2 feet of elevation, in addition to what may be required for any given distance forward. It is not doubted that water power may often be advantageously substituted for stationary steam power on the route of the intended road. Coal will be abundant, as the road itself passes through districts where it is inexhaustible, and of the best quality. The use of locomotive engines is likely, we believe, to be recommended by considerations of both rapidity and economy in the carriage. The engineers who, as will be seen, have recently been sent out to England, will collect everything new on this subject; and, in the mean time, the road is so constructed as to allow of the employment of either horsé or steam power. But we must quit these details, concluding with the remark of the Engineers, that while they have no reason to question the justness of the views they have given on these various subjects, they cannot pretend that their opinions are fully matured, and will be wholly sustained by future experience. A wide, and comparatively new field of investigation is to be explored. The Board of Directors, under this conviction, despatched, in October last, to England, Captain McNeill, of the United States' Engineers, Mr Knight, civil engineer, and Lieutenant Whistler, also of the United States' Engineers, to possess themselves of accurate information respecting all recent improvements in the construction of rail roads, and the application of moving power upon them, so as to complete their work in a manner the most economical and efficient. It is their purpose, on the return of these gentlemen, to prosecute their enterprise on a still more enlarged scale.

We have incidentally mentioned some of the productions of the country which is to be traversed by the road, when speaking of the materials of its construction. These must also become articles of trade, in the event of its completion. Nature seems to pursue a kind of compensatory system in depositing

her greatest mineral wealth where the surface is most rugged. The marble, the lime, the slate, the lumber, &c. of this region, only want convenient access to market in order to become highly valuable. Inexhaustible beds of iron ore, already worked to a considerable extent, have been found on all the routes examined for the road; and when there shall be a facility of transportation both for the coal used in its preparation, and the commodity when manufactured, this branch of industry must be greatly augmented. So abundant is the coal, and so easily procurable, in the vicinity of Cumberland, that it is used for fuel in places where the timber lies rotting on the soil. Its fitness for the manufacture of iron has been tried with success. To the point where this most important mineral is found so abundantly, there seems no reason to doubt the quick and easy construction of the road; and the results to Baltimore must necessarily be important. On this part of the subject it must be added, that the region on and contiguous to the Potomac and its waters, is highly agricultural, and already abundant in the wealth of the soil. Ellicotts' Mills, so often mentioned in describing the course of the road, is a flourishing village, on the Patapsco, which affords a large water power. Important manufactures exist at this spot, which contains a population of one thousand five hundred souls. But the road once opened to the Ohio, the products of that vast and fertile region must inevitably swell the trade of the rail road to a vast amount. A sense of their interest in the present undertaking has awakened the attention of the whole country along the route, and caused the actual or promised donation of the land necessary for the road, through the greater part of its course. An actual cession, without charge, of the necessary quantity has been made on that part of the line under contract, as also the right of quarrying for stone. The Company are assured that a similar disposition generally prevails on the route between Ellicotts' Mills and the Potomac. From the point where the road intersects that river, as far as Cumberland, they already hold deeds or full relinquishments at nearly all the important points.

The present stock of the Company is four millions of dollars, of which the state of Maryland and the Corporation of Baltimore hold each half a million. The talent and experience which have been employed, give assurance that this fund is not likely to be thrown away in an idle and fruitless scheme. The Company possess, in Philip E. Thomas, Esq. of Balti-

more, a very active and efficient president. Their board of Engineers consists of Colonel Long, J. Knight, Esq., and Captain McNeill. Dr Howard, of the United States' Engineers was engaged in the *reconnaissance* and preliminary surveys on which the first report of the Engineers is founded ; and the Engineer Department liberally gave the assistance of a number of the officers of the army. The Superintendent is Casper Weaver, Esq. Arrangements are making to complete forthwith the construction of the first twelve miles of the road, and place carriages on them, that there may be a return to the Company on its expended stock with the least possible delay. There are at present about two thousand laborers engaged on the road. The Directors assure the stockholders of their unabated confidence of success ; and that, with a judicious application of their funds, they shall achieve the timely completion of a road that will secure the utmost facility of intercourse between Baltimore and the Ohio.

ART. X.—1. *History of the States of Antiquity.* From the German of A. H. L. HEEREN, Professor of History in Göttingen, and Member of the Royal French Academy of Inscriptions. 1 vol. 8vo. Northampton, Mass., and New York. 1828.

2. *History of the Political System of Europe and its Colonies, from the Discovery of America to the Independence of the American Continent.* From the German of A. H. L. HEEREN, Professor of History in Göttingen, and Member of the Royal French Academy of Inscriptions. 2 vols. 8vo. Northampton, Mass., and New York. 1828.

ALTHOUGH the name of the translator of these works does not appear upon the titlepage, and accordingly is not placed at the head of this article, yet we do not scruple to make use of it here, in order that our readers may be assured, from the first, that the work is executed by an accomplished hand. Besides, the translation does not claim to be anonymous, and we are justified in the license we take, if it be a license, by the fact that the name of Mr Bancroft is affixed to the Preface ; a gen-